DISCOVERY MISSIONS IN THE JOVIAN SYSTEM: WATCHING IONIAN VOLCANIC ERUPTIONS

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Io, the most volcanically active body known in the Solar System, offers a unique opportunity for the study of planetary volcanism at both large-scale (interior dynamics) and small-scale (modelling of flows and plumes). While the enormous extent of Io's volcanic activity was established from the Voyager data, the precise nature of this volcanism is still poorly understood. Most of the major science questions remaining can only be fully addressed by a long-term survey of Io with good spectral coverage and high spatial resolution over time. Voyager's initial survey of Jupiter and its satellites will be followed by Galileo's in-depth study of the Jovian system starting in 1995. However, GalileoJs coverage of Io will mainly address global issues, since its spatial and spectral capability will not be sufficient to allow a detailed study of Io's eruptive patterns and surface volcanic features.

Even after the observations from Galileo and from Earth, there will remain many unresolved questions concerning the"relationship between Io's volcanic and tectonic features and its bulk composition and geophysical evolution. These include (i) the roles of sulphur, silicates, and SO_2 on Io's eruptions and surface renewal; (ii) the mineralogical and chemical changes in the composition of effusive materials with time; (iii) the extent and distribution of SO_2 frost on the surface with time; (iv) the distribution of Io's eruption rates and resurfacing rates; (v) the relative frequency of explosive volcanism (plumes) versus effusive volcanism (flows) and the temporal variability of volcanic activity; (vi) the temperatures of flows and hot spots and how these temperatures vary during activity; (vii) the injection rate of material into Io's atmosphere. These scientific issues can be resolved with a dramatic improvement in temporal. coverage (nearly continuous observations) and in spatial resolution (particularly in the IR) over those for Galileo. These are achievable in either equatorial or polar orbits having perijove at 10 Jupiter radii.

The Discovery program can provide sufficient resources to achieve an exciting and scientifically rewarding mission to Io. The special problem of the high radiation environment at Io can be solved by utilizing a sufficient stand-off distance (at Europa's orbit) . Technical challenges include demonstrating that RTG's can be replaced with solar arrays as the power source for a mission near Jupiter, identifying a proven lightweight spacecraft, and reducing the cost of operations for long cruises.